Taylor & Francis Online

Journal
Cogent Engineering
Volume 2, 2015 - Issue 1

Exergy costing analysis and performance evaluation of selected gas turbine power plants

S.O. Oyedepo, R.O. Fagbenle, S.S. Adefila & Md.Mahbub Alam | Duc Pham (Reviewing Editor)

Article: 1101048 | Received 07 Jul 2015, Accepted 10 Sep 2015, Accepted author version posted online: 07 Oct 2015, Published online: 30 Nov 2015

- https://doi.org/10.1080/23311916.2015.1101048

Abstract

In this study, exergy costing analysis and performance evaluation of selected gas turbine power plants in Nigeria are carried out. The results of exergy analysis confirmed that the combustion chamber is the most exergy destructive component compared to other cycle components. The exergetic efficiency of the plants was found to depend significantly on a change in gas turbine inlet temperature (GTIT). The increase in exergetic efficiency with the increase in turbine inlet temperature is limited by turbine material temperature limit. This was observed from the plant efficiency defect curve. As the turbine inlet temperature increases, the plant efficiency defect decreases to minimum value at certain GTIT (1,200 K), after which it increases with GTIT. This shows degradation in performance of gas turbine plant at high turbine inlet temperature. Exergy costing analysis shows that the combustion chamber has the greatest cost of exergy destruction compared to other components. Increasing the GTIT, both the exergy destruction and the cost of exergy destruction of this component are found to decrease. Also, from exergy costing analysis, the unit cost of electricity produced in the power plants varies from cents 1.99/kWh (N3.16/kWh) to cents 5.65/kWh (N8.98/kWh).

Keywords: exergy analysis, economic analysis, gas turbine, exergy cost, levelized cost, F-rule, P-rule

Additional information

Author information

S.O. Oyedepo

S.O. Oyedepo is presently a senior lecturer in the Department of Mechanical Engineering, Covenant University, Nigeria. His PhD research work was on *Thermodynamic Performance Analysis of Selected Gas Turbine Power Plants in Nigeria*. He has published over 45 papers in national /international journals and conferences. His major contributions in the area of energy systems and environmental noise is the publication of research and review papers in the leading journals, i.e. *Renewable and Sustainable Energy Reviews, Energy Conversion and Management*, *Energy Exploration & Exploitation, Environmental Monitoring Assessment and Journal of Environmental Studies.* His research interest includes but not limited to: Thermal System Design and Optimization, Energy management and Energy conversion systems, Heat Transfer Analysis, etc. Oyedepo is a registered engineer in Nigeria and member of Nigerian Society of Engineers.

Funding

Funding. Alam wishes to acknowledge supports given to him from the Research Grant Council of Shenzhen Government [grant number KQCX2014052114423867], [grant number JCYJ20130402100505796] and [grant number JCYJ20120613145300404].